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APPLICATION FOR PATENT

ON

CORDLESS COMPRESSOR

BY

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CORDLESS COMPRESSOR

CROSS REFERENCE

[0001] The present application claims priority under 35 U.S.C. §119(e) to United States Provisional Patent Application Serial Number 60/442,870, entitled: *Cordless Compressor*, filed on January 27, 2003, which is hereby incorporated by reference in its entirety.

FIELD OF THE INVENTION

[0002] The present invention generally relates to the field of power tools and more particularly to a battery powered pneumatic compressor having a dual electrical power capability.

BACKGROUND OF THE INVENTION

[0001] Pneumatic tools have proliferated jobsites and workshops. While pneumatic tools have increased in popularity, jobsites often lack sufficient access to electrical services, or the electrical services provided are limited or are remotely located. As a result, tradesmen using pneumatic tools typically have to share limited electrical outlets, carry large lengths of extension cords, long air hoses, and the like to accommodate site conditions. For example, roofers use long hoses to connect to a compressor on the ground floor. In another example, a new home construction site may only have a temporary utility pole set-up on the lot. Further, compressors employing gasoline engines may be noisy, heavy, create fumes, require re-fueling, and may be difficult to transport over uneven ground.

[0002] In some instances, fuel canister nail guns have been utilized in place of pneumatic fasteners to overcome the difficulties in obtaining an appropriate supply of air. Drawbacks to this type of tools include cost, maintenance, the high cost of fuel

canisters/the often propriety nature of the fuel/canisters, in some instances the need for specialty fasteners, and the like.

[0003] Additionally, pneumatic compressors typically have a (relatively) high energy demand. For example, a 4 (four) gallon compressor operating at in the range of 135 psi to150 psi (pounds per square inch) may require in the range of 10-15 amps in order to compress the air sufficiently to operate a pneumatic device such as a pneumatic fastener, an impact wrench and the like. Therefore the compressor must pressurize a sufficient quantity of air to at least a minimum operating pressure in order for the pneumatic device to operate properly. For instance, a brad nailer typically requires a much smaller quantity of air to drive a brad nail than is required for a framing nailer to drive a large nail such as a 16d (sixteen penny nail). As a result, a pressure tank is typically included to store a sufficient quantity of air in order to meet a user's short term demand (e.g., a few shots of a pneumatic fastener in quick succession, a burst from an impact wrench sufficient to secure a lug nut), thereby allowing the compressor pump to "catch-up", or making no demand on the compressor pump. While the compressor usually is configured to handle a temporary demand of the type described above, the additional compressed air stored in a tank is usually surplus of air which may never be effectively utilized. In the foregoing situation, the compressor pump may expend a (relatively) large amount of energy in order to pressurize the air, in comparison to the energy expended to pressurize the air which is utilized to operate the pneumatically power device or attachment.

[0003] Therefore, it would be desirable to provide a compressor capable of utilization in environments lacking an electrical supply while providing a suitable airflow without the drawbacks previously experienced.

SUMMARY OF THE INVENTION

[0004] Accordingly, the present invention is directed generally to a cordless pneumatic compressor having a dual electrical power capability.

[0005] In an aspect of the present invention, an air compressor includes a pump for generating a supply of compressed air. A motor is coupled to the compressor pump in order to provide mechanical energy sufficient to generate the supply of compressed air. An electrical system including a docking station, an electrical supply connection device and a switch is electrically coupled to the motor. The docking station is constructed to receive a removable rechargeable battery. In a further embodiment, a battery for which the docking station is configured to receive is operable for use with at least one battery powered tool. The switch is configured to varying the source of electrical energy to be supplied to the motor between the battery and a conventional electrical supply provided by the electrical supply connection device. The electrical system is additionally configured to charge a removable battery (received in the docking station), if electrical supply connection device is supplying electricity to the motor and a battery is present in a docking station.

[0006] In a further aspect of the invention, an air compressor includes a pump for generating a supply of compressed air. A motor is coupled to the compressor pump in order to provide mechanical energy sufficient to generate the supply of compressed air. An electrical system including a docking station, an electrical supply connection device and a switch is electrically coupled to the motor. The docking station is constructed to receive a removable rechargeable battery. The switch is configured to automatically vary the source of electrical energy to be supplied to the motor to the battery if no electricity is supplied from the electrical supply connection device. The electrical system is additionally configured to charge a removable battery (received in the docking station), if electrical supply connection device is supplying electricity to the motor and a battery is present in a docking station.

[0007] It is to be understood that both the foregoing general description and the following detailed description are exemplary and explanatory only and are not restrictive of the invention as claimed. The accompanying drawings, which are incorporated in and

constitute a part of the specification, illustrate an embodiment of the invention and together with the general description, serve to explain the principles of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008] The numerous advantages of the present invention may be better understood by those skilled in the art by reference to the accompanying figures in which:

FIG. 1 is a perspective view of a compressor in accordance with an aspect of the present invention;

FIG. 2 is a perspective view of a compressor in accordance with an aspect of the present invention;

FIG. 3 is a side elevation view of the compressor of FIG. 1;

FIG. 4 is a diagrammatic layout of an exemplary compressor; and

FIG. 5 is a perspective view of a bucket compressor in accordance with an aspect of the present invention;

FIG. 6 is a partial cut-away view of the compressor of FIG. 5;

FIG. 7 is a perspective view of a bucket compressor including a retractable cord in accordance with an aspect of the invention; and

FIG. 8 is a partial cut-away view of the compressor of FIG. 7.

DETAILED DESCRIPTION OF THE INVENTION

[0009] Reference will now be made in detail to the presently preferred embodiments of the invention, examples of which are illustrated in the accompanying drawings. Those of skill in the art will appreciate that the apparatus of the present invention may be implemented with various compressors without departing from the spirit and scope of the present invention.

[0010] Referring to FIG. 1, a compressor 100 in accordance with an aspect of the present invention is disclosed. In the current aspect, the compressor 100 is a portable frame compressor. For instance, the compressor may be configured for utilization with a small

demand fastener (a fastener requiring a small quantity of compressed air to operate) such as a finish nailer, or brad nailer. In further embodiments, a compressor is sized and configured for use with larger demand devices such as framing nailers, impact wrenches, or the like which require larger quantities of air to operate than a brad nailer. In the present embodiment, the compressor 100 is sized to allow for hand transport by a single human of ordinary strength. In the present example, the compressor includes a generally tubular frame 102. For example, the frame 102 is formed with a rectangular cross-section for easy grasping. The frame may additionally act to protect the various operable components of the compressor, promote efficient/ergonomic carrying, prevent contact between a user and compressor components, and the like. The frame 102 may be generally rectangular in order to at least partially enclose compressor components such as generally in an outer cage. Other suitable enclosures may include a generally cylindrical housing (such as a general bucket shape, as may be generally observed in FIGS. 5-8) with a carry handle, wheel barrow type frame, a pancake type compressor configuration, and the like. In additional embodiments, a compressor may be configured for large demand devices, operate several finish nailers, or the like.

[0011] A pump 104 is included in the compressor for generating a supply of compressed air. For instance, a pneumatic pump may generate a 90 psi (ninety pounds per square inch) air supply with a 4.0 SCFM (cubic feet per minute at standard conditions) capacity. Other pump capacities/ranges may be obtained as desired such as by including a two stage compressor pump, or configuring the pump to meet expected demands. Those of skill in the art will appreciate that various factors may be considered for pump selection including the type and number of devices which are likely to be operated from the compressor, the power requirement of the pump, the desired intervals between pump rechargings, and the like. For example, a pump may be selected to operate at 150 psi (one hundred fifty pounds per square inch) in order to provide more useful air before the pressure of the compressor's pneumatic system drops below the pressure at which an

associated tool (such as a pneumatic fastener operating at 90 psi (ninety pounds per square inch)) fails to function properly.

[0012] Referring to FIG. 2, a motor 214 is coupled to the pump 204 in order to provide the pump with mechanical energy to enable the pump 206 to generate a supply of air. In the present example, the pump is configured as a direct drive wherein a drive shaft included on a motor 214 directly provides mechanical energy to the pump (or through a gear assembly). In further embodiments, various transmission systems may be utilized (e.g., a belt drive, or the like) for transferring mechanical energy between a motor and the pump.

[0013] Preferably, a reservoir is included in the compressor. For example, two pressure tanks 106 may be pneumatically connected to the pump 104 so as to form a reserve supply of compressed air should an attachment, pneumatically connected to the compressor 100, require air. Suitable reservoir pressure tanks include dual tanks, cylindrical tanks, pancake type tanks, and the like. A condensate removal valve may be included in a reservoir, or adjacent a reservoir for draining any condensate which may accumulate in the reservoir. For example, a pair of commercially available "propane" type tanks (tanks configured for use in propane devices such as portable camp stoves, camp lanterns) may be utilized. The implementation of such "propane" tanks may be advantageous in that several tanks may be utilized to obtain the desired capacity, the tanks are typically constructed to hold pressurized material in the range expected for typical compressors. Preferably, a reservoir is selected in accordance generally with the quantity of air which may be required for an expected tool or tools. For instance, a compressor may be configured for small demand fasteners such as a finish nailer, or for large demand attachments such as framing nailers, impact wrenches, or where multiple small demand tools (in relation to the operating parameters of the pump) are expected.

[0014] While a reservoir capacity is configured to allow for an expected tool's consumption, additional capacity may result in a less effective compressor. For example, should a user fire several fastener shots in rapid succession the supply of compressed air stored in the two tanks 106 may have sufficient reserve so that the pump 104 is not required to operate, or the reserve air in the tanks 106 may allow for the pump 104 to catch up (e.g., recover) with the short term demand. In a further example, if a pressure tank is configured to store a large capacity of air in relation to the amount of air to be consumed by a tool, the compressor's pump must pressurize not only the air which is to be consumed, or likely to be consumed by the pneumatic tool, but also the additional quantity of air which may never be effectively used, to a pre-selected pressure. For example, while one cubic foot of air is likely to be consumed by an associated tool, before the pump is required to recharge, a system having 2 cubic feet capacity may not make effective use of the additional storage capacity. Further, if the tank system is included in a compressor capable of operating from a battery source, it may be preferable to include a valve to pneumatically isolate an individual tank so that a user may have the option of operating from a smaller reservoir in order to diminish the excess pneumatic storage capacity and thereby allow a pump to generate a greater quantity of useable air. For example, if a carpenter is utilizing a brad nailer, while the compressor is operating from battery power, a second storage tank may be unnecessary for the brad nailer's demand. Thus, a user may isolate a first tank to make more efficient use of the electricity stored in the battery. In the preceding example, the compressor pump is thus freed-up from having to re-pressurize or recharge the second tank when the compressor's system pressure drop below a minimum pressure. Alternatively, a reservoir, included in a battery powered compressor, may be sized so as to minimize the amount of excess air storage capacity in relation to the pump such that the power provided by a battery source results in a maximized amount of useful air.

[0015] Representative tools include pneumatic fasteners, pneumatic tools such as impact wrenches, air ratchets, air powered sanders, blow guns, fill needles, and the like. These

type of tools may be connected via a pneumatic hose configured to transport compressed air. Suitable hoses may be configured to transport air having a pressure generally in the range of 90 psi (pounds per square inch) to 200 psi (pounds per square inch). For example, a pneumatic stapler may be connected via a quick connect coupling to a hose which in-turn is quick connect coupled to a compressor. Referring now to FIG. 1, preferably a manifold 108 may be included on the compressor 100 with a pressure gauge 110 for indicating the supply pressure and a valve 112 such as a diaphragm valve, or the like for regulating the pressure to the attachment. In the current embodiment, several quick connect couplings may be included in the manifold for coupling several pneumatic devices to the compressor. A relief valve/bleed valve 216 (FIG. 2) may be included to prevent the compressor's system pressure from exceeding a pre-selected limit, or to allow for quick pressure reduction. Quick connect couplings may include a spring biased female connector for receiving a male connector therein.

[0016] Referring to FIG. 2 and 3, an electrical system is included in the compressor 200. The electrical system is electrically connected to the motor 214. At least one docking station, for receiving a removable battery, is included in the electrical system. In the present embodiment, two docking stations (respectively a first docking station 218 and a second docking station 220) are included in the electrical system. In embodiments where multiple docking stations are utilized, the compressor electrical system may be constructed so as to draw electricity from batteries (received in the docking stations) in parallel, or concurrently such as when power is unavailable from a conventional power source (e.g. a commercially available alternating current source). In additional embodiments, a user operated switch may be included to allow the user to select from which battery/docking station power is to be drawn. Alternatively, an automatic switch may be included to switch from a first battery/docking station to second docking station based on a removable battery's available power, if a battery is coupled to the docking station, and the like.

[0017] Preferably, a docking station is configured to receive a rechargeable battery such as a battery constructed to be utilized with a (cordless or battery powered) tool. For example, a rechargeable removable battery may be configured to operate with an individual tool, or more preferably, a family of tools. Representative suitable tools include drills, circular saws, reciprocating saws, flashlights, routers, jig saws, sanders, radios, and the like. For instance, a docking station may be constructed to physically (by a particular rail/groove system) and electrically (via a complimentary electrical terminal system) receive a removable rechargeable battery such as a tool battery. Preferably, the docking station is constructed to operate with a battery operating in the range of approximately 12V (twelve volts) to 24V (twenty-four volts). For example, the compressor may be configured to operate in conjunction with a 19.2V (nineteen point two volt) INTERCHANGEABLE NETWORK battery such as sold by Porter-Cable Corporation, Jackson, TN. Those of skill in the art will appreciate that other commercially available proprietary battery systems such as a 30V (thirty volt) battery may be implemented as desired. In advantageous embodiments, a docking station is configured so as to prevent dust and debris from fouling or preventing a battery from being received in the docking station. For instance, a dockings station may be configured so that dust falls away from the area in which a battery is received. In still further embodiments, a cover is included for preventing the ingress of dust and debris into the portion of the docking station for receiving a battery. Suitable covers include hard sliding covers, flexible flap type covers and the like.

[0018] An electrical supply connection device such as a power cord 226 is included for connecting the compressor electrical system to a conventional power supply. For instance, the cord 226 may be constructed to connect to a 115V (one hundred fifteen volt) 60 Hz (sixty hertz) alternating current power source as is commercially available. In additional embodiments, an electrical supply connection device may be configured to be removable from the compressor. For example, a removable cord, having a first end and a second end may include a set of three prongs (e.g. two current carrying terminals and a

ground terminal) for connection to a standard power supply on the first end and a female plug connector on the second having a corresponding number of connections for connecting to a complimentary plug included on the main body of the compressor. Alternatively, a retractable electrical supply connection device may be utilized. For example, a biased reel 828 (FIGS. 7 and 8) may be utilized to allow a user to retract a power cord 826 into the main body (e.g., an enclosure or housing) of the compressor when not in use.

[0019] Referring to FIG. 4, a switch 430 is included in a compressor electrical system 434 for varying or selecting the source of the power to be provided between a battery received in a docking station (or docking stations 418 and 420 respectively) and a conventional power supply 432 such as a building's electrical system supplied by the electrical power supply connection device. In a preferred embodiment, an automatic switch automatically varies the power source from the conventional source to a battery source, if electricity is not provided from the conventional source 432, or if no conventional source is available. Conversely, an automatic switch may vary from a removable battery should power be provided from a conventional power supply. In further embodiments, a user actuated switch may be implemented to vary, or select the source of the power provided to the motor 414 between a battery received in a docking station and a conventional source. Preferably, a compressor electrical system 434 is configured to charge a removable battery received in a docking station, if a conventional power supply is providing electricity to the compressor's motor 414. Those of skill in the art will appreciate that a compressor electrical system 434 may be configured to sequentially draw power from multiple batteries, if more than one battery is received by the electrical system. Alternatively, a compressor electrical system may concurrently draw power from multiple batteries received in docking stations (when a battery is present) included in the electrical system, if electricity is not provided from a conventional power source.

[0020] Preferably, a voltage regulator is included in the compressor electrical system 434 for converting the voltage of the electricity received from a conventional power supply to a voltage substantially equal to the electrical system's voltage. For example, the voltage regulator may be configured to convert a 115V (one hundred fifteen volt) conventional supply to a 19.2V (nineteen point two volt) supply (corresponding to a voltage equal to the voltage provided for which a docking station is configured to receive from a battery). Additionally, a rectifier may be included for converting a conventional alternating power supply to a direct current. (As may be seen in FIG. 4, a combination voltage regulator/rectifier 436 may be utilized.) For example, a direct current motor is implemented to operate at 24V (twenty-four volts) which is substantially equal to a voltage for which the docking station is constructed to receive from a removable rechargeable battery. Alternatively, a battery voltage may be stepped up for use by the motor.

[0021] Preferably, a motor switch 438 is included in a compressor electrical system. For example, a motor switch is configured to control the operation of the motor 414/pump 404 based on the compressor's pneumatic pressure. If the compressor's pneumatic system drops below a pre-selected minimum pressure, the motor switch may turn-on or activate the motor 414 and recharge the compressor's pneumatic system. In addition, a motor switch may allow a user to manually switch the motor on/off. Referring to FIG. 5, a manual "on/off" motor switch 540 may be included to override the motor switch, thereby permitting/preventing the associated compressor motor from being activated, based on user selection.

[0022] Referring now to FIGS. 5 and 6, in an aspect of the present invention a battery powered compressor 500 is configured in a generally cylindrical enclosure 542. For example, the compressor enclosure or housing may be configured generally as a "bucket" with a carrying handle 544. A tool tray 546 or recessed portion of the compressor may be included for carrying attachments such as pneumatic tools (e.g., a pneumatic nailer).

Preferably, the compressor 500 is sized for being hand carried by a user. For example, the compressor components may be sized for smaller quantity consuming devices such as a brad nailer, small frame staplers, finish nailers, and the like. For instance, a finish carpenter may wish to have a portable compressor, capable of operating from a removable rechargeable battery or from a conventional source, which is easily transferred between jobsites, or around a jobsite. A docking station 520 may be mounted external to the enclosure 542 to allow for operation from a received removable battery 522, if electricity is not received from a conventional source, or to allow for battery charging, if electricity is provided from a conventional source. For example, a compressor 500 may be utilized to charge a removable battery 522 constructed for use with a battery powered tool such as a battery powered circular saw. Alternatively, a docking station may be formed internally to the enclosure 542. For example, a docking station may include a mechanical/electrical connection which allows a battery524 to be slid into a rib/groove mechanical connection so as to electrically connect to the compressor's electrical system. Preferably, a docking station is configured to prevent the ingress of dust and debris from fouling the mechanical/electrical connection, or to allow dust/debris to escape via a chute or aperture.

[0023] Additionally, a retractable pneumatic hose 548 may be included in the compressor 500. For example, a reel may be included to allow the hose 548 to retract/extend from the enclosure 542. In further embodiments, the reel may be biased such that the hose self-rewinds. In alternative embodiments, a pneumatic quick couple connection may be included to allow for a removable hose connection.

[0024] Referring now to FIGS. 7 and 8, in a further embodiment of the invention a retractable electrical cord 726 is included in a compressor. For example, a biased reel may be included for retracting a electrical cord for storage.

[0025] It is believed that the apparatus of the present invention and many of its attendant advantages will be understood by the foregoing description. It is also believed that it will be apparent that various changes may be made in the form, construction and arrangement of the components thereof without departing from the scope and spirit of the invention or without sacrificing all of its material advantages. The form herein before described being merely an explanatory embodiment thereof. It is the intention of the following claims to encompass and include such changes.